

State of California  
AIR RESOURCES BOARD

EXECUTIVE ORDER D-253  
Relating to Exemptions Under Section 27156  
of the Vehicle Code

FUEL EFFICIENCY SYSTEMS, INC.  
THERMAL-CHARGER #500

Pursuant to the authority vested in the Air Resources Board by Section 27156 of the Vehicle Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order E-45-5;

IT IS ORDERED AND RESOLVED: That the installation of the Thermal-Charger #500 manufactured by Fuel Efficiency Systems, Inc. of 4007 Pretense Ct., Fair Oaks, California, 95628, has been found not to reduce the effectiveness of required motor vehicle pollution control systems and, therefore, is exempt from the prohibitions of Section 27156 of the Vehicle Code for 1992 and older model-year heavy-duty diesel-powered motor vehicles.

This Executive Order is valid provided that installation instructions for this device will not recommend tuning the vehicle to specifications different from those submitted by the vehicle manufacturer.

Changes made to the design or operating conditions of the device, as exempted by the Air Resources Board, that adversely affect the performance of a vehicle's pollution control system shall invalidate this Executive Order.

Marketing of this system using an identification other than that shown in this Executive Order or marketing of this system for an application other than those listed in this Executive Order shall be prohibited unless prior approval is obtained from the Air Resources Board. Exemption of a kit shall not be construed as exemption to sell, offer for sale, or advertise any component of a kit as an individual device.

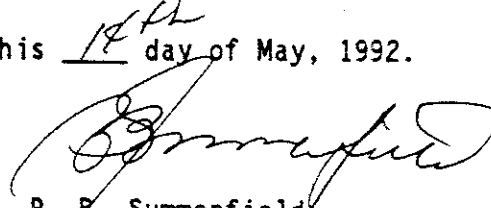
This Executive Order does not constitute any opinion as to the effect that the use of this device may have on any warranty either expressed or implied by the vehicle manufacturer.

THIS EXECUTIVE ORDER DOES NOT CONSTITUTE A CERTIFICATION, ACCREDITATION, APPROVAL, OR ANY OTHER TYPE OF ENDORSEMENT BY THE AIR RESOURCES BOARD OF ANY CLAIMS OF THE APPLICANT CONCERNING ANTI-POLLUTION BENEFITS OR ANY ALLEGED BENEFITS OF FUEL EFFICIENCY SYSTEMS, INC.'S THERMAL-CHARGER #500.

No claim of any kind, such as "Approved by Air Resources Board" may be made with respect to the action taken herein in any advertising or other oral or written communication.

Violation of any of the above conditions shall be grounds for revocation of this order. The order may be revoked only after a ten-day written notice of intention to revoke the order, in which period the holder of the order may request in writing a hearing to contest the proposed revocation. If a hearing is requested, it shall be held within ten days of receipt of the request and the order may not be revoked until a determination after hearing that grounds for revocation exist.

Executed at El Monte, California, this 14th day of May, 1992.



R. B. Summerfield  
Assistant Division Chief  
Mobile Source Division

State of California  
AIR RESOURCES BOARD

EVALUATION OF FUEL EFFICIENCY SYSTEMS, INC.  
THERMAL-CHARGER #500 FOR EXEMPTION FROM THE PROHIBITIONS  
OF VEHICLE CODE SECTION 27156 IN ACCORDANCE WITH SECTION 2222,  
TITLE 13, OF THE CALIFORNIA CODE OF REGULATIONS

May 1992

State of California  
AIR RESOURCES BOARD

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THERMAL-CHARGER #500 FOR EXEMPTION FROM THE PROHIBITIONS  
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TITLE 13, OF THE CALIFORNIA CODE OF REGULATIONS

by

Mobile Source Division  
State of California  
Air Resources Board  
9528 Telstar Avenue  
El Monte, CA 91731-2990

(This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.)

### SUMMARY

Fuel Efficiency Systems, Inc. of 4007 Pretense Ct., Fair Oaks, California, 95628, has applied for exemption from the prohibitions in Section 27156 of the California Vehicle Code for the Thermal-Charger #500 device. The device is designed for installation on 1992 and older model-year heavy-duty diesel-powered vehicles.

Thermal Charger #500 is a heat exchanger which uses the engine coolant to heat up the fuel supply to the engine to 155 degrees F. This is to achieve easy engine start-up in cold weather. Based on an engineering evaluation of the device, the staff has concluded that the device will not adversely affect exhaust emissions from the vehicles for which the exemption is requested.

The staff recommends that Fuel Efficiency Systems, Inc. be granted an exemption for their Thermal-Charger #500 for installation on 1992 and older model-year heavy-duty diesel-powered vehicles and that Executive Order D-253 be issued.

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I. INTRODUCTION

Fuel Efficiency Systems, Inc. of 4007 Pretense Ct., Fair Oaks, California 95628, has applied for an exemption from the prohibitions of Vehicle Code Section (VC) 27156 for the Thermal-Charger #500 device. The device is designed for installation on 1992 and older model-year heavy-duty diesel powered vehicles. The applicant submitted installation instructions and specifications of the device for evaluation.

II. CONCLUSIONS

Based on an engineering evaluation of the device, the staff concludes that the device will not adversely affect exhaust emissions from 1992 and older model-year heavy-duty diesel-powered vehicles.

III. RECOMMENDATION

The staff recommends that Fuel Efficiency Systems, Inc. be granted an exemption from the prohibitions in California Vehicle Code Section 27156 for the Thermal-Charger #500 device for installation on 1992 and older model-year heavy-duty diesel-powered vehicles and that Executive Order D-253 be issued.

#### IV. DEVICE DESCRIPTION

The Thermal-Charger is a thermally activated diesel fuel heating and control system consisting of a one inch outside diameter heat exchanger, 60 inches long, coiled in a 10 inch diameter by 2 inches thick. The interior of the exchanger is a copper engine water coolant tube surrounded by a twisted spiral carbon steel fuel passage that allows fuel to flow in a counter flow direction around the inner water tube. The dual wall heat exchanger feature prevents water to fuel, or fuel to water contamination, should there be a defect in either tube.

The control valve is made of cast iron and machined to close tolerances for accurate control of the fuel temperature. The valve is approximately 5 inches long and 7 inches high with fuel inlet and outlet fittings connecting various lines from the tank and engine. These supply the fuel to the proper ports (see drawings in Appendix B).

The valve and heat exchanger are mounted on the frame or engine, space permitting, as close as possible to the fuel filter inlet port in the existing engine fuel line.

Depending on the engine power settings, the fuel flowing from the injector bypass line (formerly returned to the fuel tank) varies in temperature and volume. This warm/hot fuel is now routed back through the Thermal-Charger's control valve and blended with additional hot fuel from the heat exchanger or with fresh fuel from fuel tank to maintain a desired 155 degrees F. Fuel flowing into the control valve from the fuel tank is routed through either the dual wall heat exchanger or directly into mixing chamber to dilute hot fuel returning from the fuel injector bypass line. A temperature sensing wax motor valve element controls and stabilizes the temperature at 155 degrees F.



V. DISCUSSION

Cold ambient temperatures frequently causes problems in the operation of the internal combustion engines, especially diesel engines. Pre-heating the fuel for a diesel engine before injection could improve the engine operation. As with other fuel pre-heaters available in the market, the Thermal-Charger #500 uses hot coolant to preheat the fuel. The manufacturer claims the device is distinct from other pre-heaters because the diesel fuel is heated and controlled at 155 degrees F before injection into the combustion chamber. This results in reduced viscosity of the fuel and facilitates smaller injector spray droplets producing a more complete combustion of the fuel.

Staff did not conduct any test to confirm manufacturer's claims. The staff has evaluated the design and operation of the Thermal-Charger #500. Based on engineering principles, the staff has determined that the device when installed in series with the diesel engine fuel system will not adversely affect the performance of the factory equipped emission control systems on 1992 and older model-year heavy-duty diesel-powered vehicles.

## APPENDIX A

## THERMAL-CHARGER DIESEL FUEL HEATER INSTALLATION PROCEDURE

Blow out all parts with compressed air before starting installation. Refer to the flow schematic for proper routing of fuel lines. If no fuel pump is installed in line ahead of the injector pump, it is best to pour fuel into port #12 with a hose and funnel, held higher than the fitting connecting the filter from port #20. Loosen the fitting connecting port #20 to the filter so that all air in the system can bleed out. It is important that control valve port #20 be mounted in the up position so that all air is purged from the valve during normal operating conditions. If an auxiliary pump is installed so that it pumps fuel through the fuel heating system, bleed the air out through the fitting connecting port #20 to the filter.

BE SURE TO WIPE UP ANY FUEL SPILLED DURING THE AIR BLEEDING PROCEDURE SO THAT A FIRE DOES NOT START FROM THIS FUEL AND NO POLLUTION OCCURS.

Cold fuel enters the temperature control valve from the fuel tank through port #12, flows out port #24 to the fuel inlet on the outer shell of the heat exchanger. It then travels through the heat exchanger and reenters the control valve as hot fuel at port #22. Hot fuel that formerly was bypassed from the injectors and returned to the tank is now routed through the vapor separator, at port #32 and is mixed with additional hot fuel from port #22 and new cold fuel from port #12 to blend into the optimum temperature of 155 degrees Fahrenheit.

The use of 90 degree fittings during installation may cause loss of horsepower due to increased resistance in the fuel lines.

The vapor line fitting #36 from the vapor separator will be connected to the old fuel bypass line returning to the tank.

Cut the cab heater hose, (from the pressure side of the water pump and before the heater water control valve) and install a "Y" fitting in the heater hose. Run additional heater hose from the "Y" to the center tube on the end of the heat exchanger that is connected to port #22 (hottest water in to hot fuel out). Install additional heater hose to the center tube outlet, (cooler water out to cold fuel in) and run it to a "Y" and install it into the heater line returning to the suction side of the water pump.

APPENDIX B

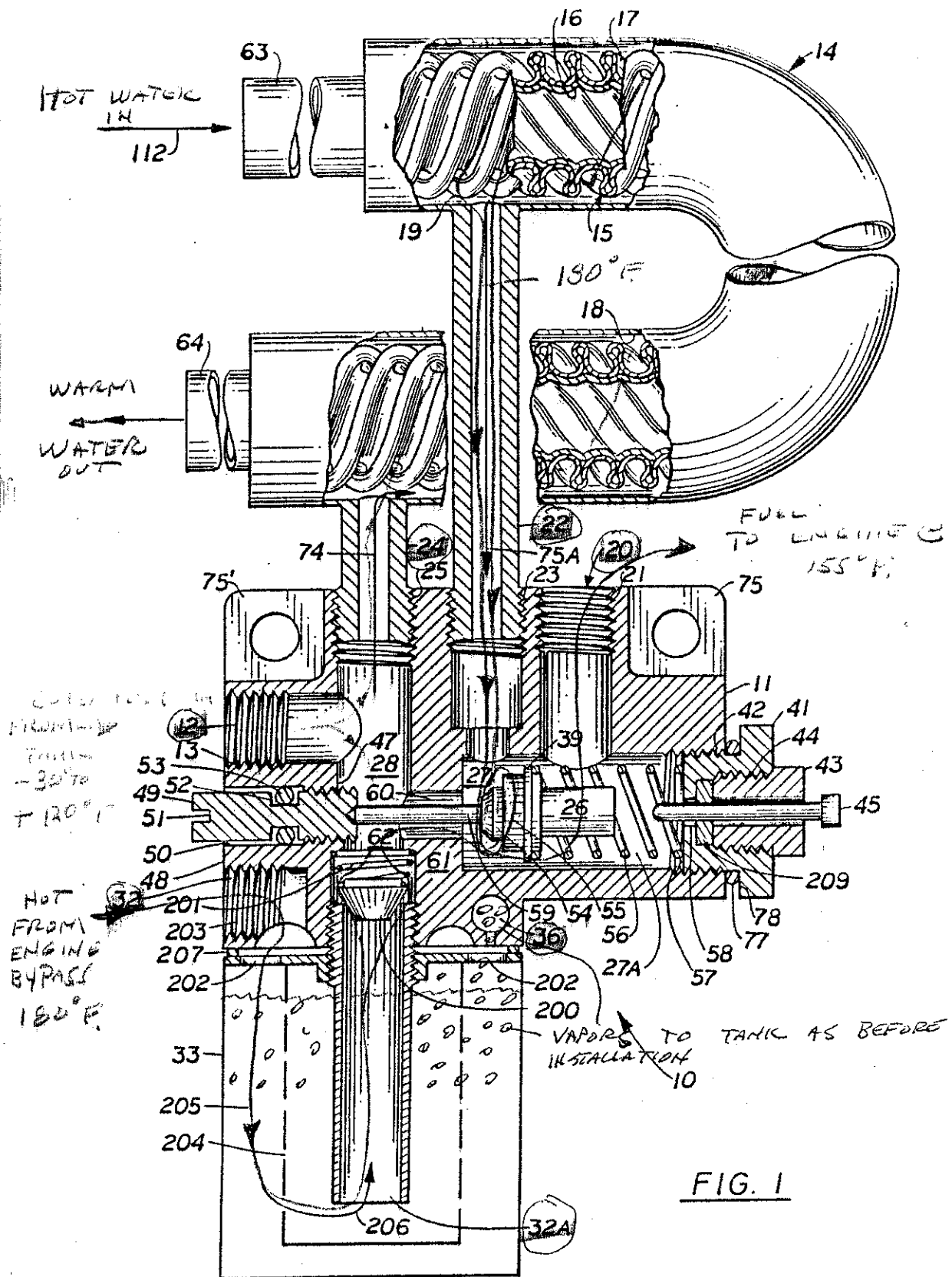


FIG. 1

VALVE ACTUAL SIZE

RED HOT

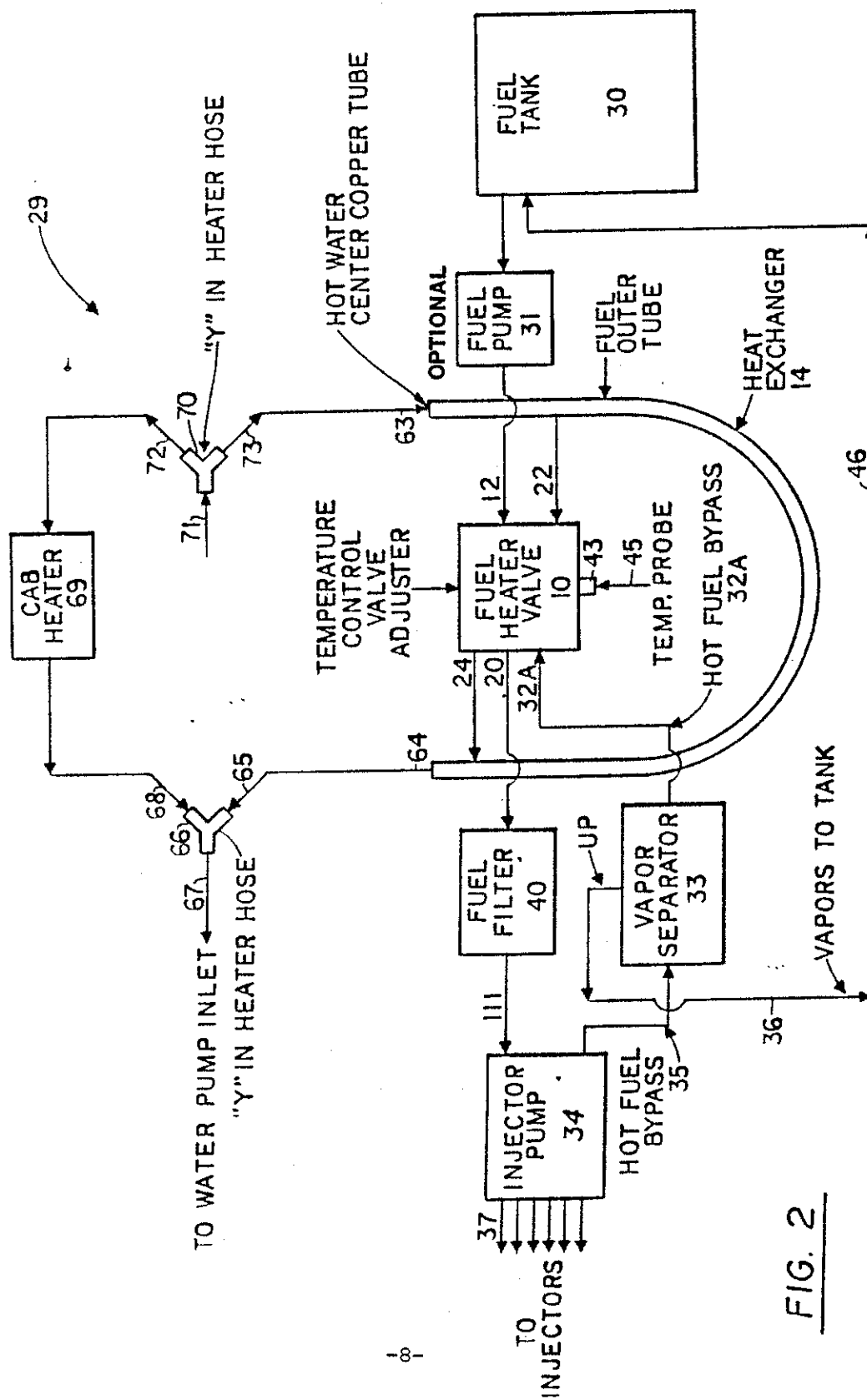


FIG. 2

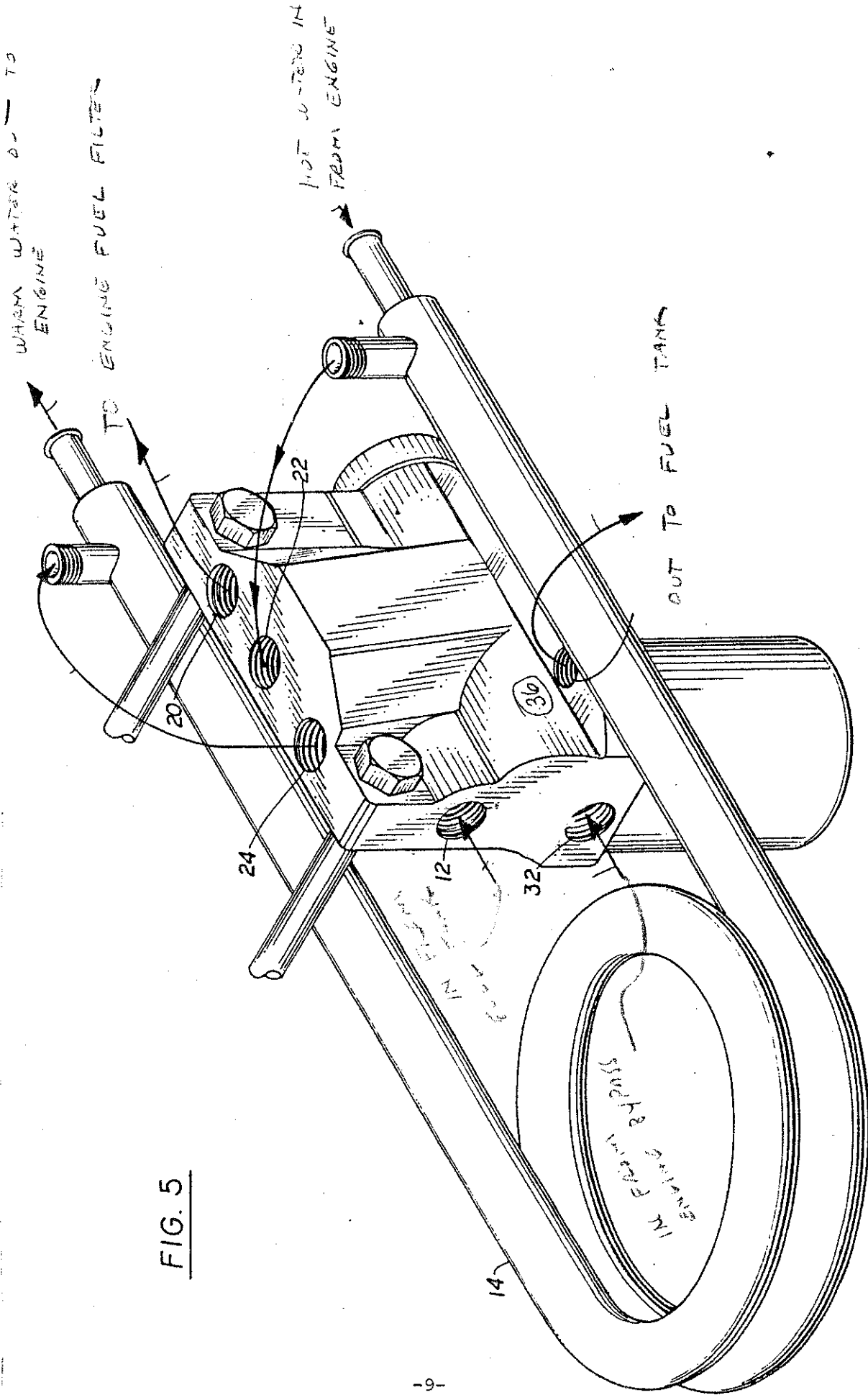


FIG. 5